

**QUALITY ASSURANCE PROJECT PLAN**  
**PART B OF THE SAMPLING AND ANALYSIS PLAN**  
**APPENDIX A OF THE REMEDIAL ACTION MANAGEMENT PLAN**

**LANDFILL REMOVAL  
FORMER NPD LABORATORY  
TROUTDALE, OREGON**

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## **ATTACHMENT**

### **ATTACHMENT A - LABORATORY REPORTING LIMITS AND CLEANUP LEVELS**

## ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing and Materials
Bgs	below ground surface
Cherokee	Cherokee General Corporation
CLP	Contract Laboratory Program
COR	Contracting Officer's Representative
DFSI	Draft Final Site Investigation Report
DQO	data quality objective
DRO	total petroleum hydrocarbons as diesel-range-organics
EPA	U.S. Environmental Protection Agency
Farallon	Farallon Consulting, L.L.C.
FSP	field sampling plan
ML	milliliter
MS/MSDs	matrix spike/matrix duplicates
ORO	total petroleum hydrocarbons as oil-range-organics
PCBs	polychlorinated biphenyls
PID	photoionization detector
PM	project manager
Ppb	parts per billion
PPE	personal protective equipment
ppm	part per million
PRGs	preliminary remediation goals
QA	Quality Assurance
QA/QC	quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAMP	Remedial Action Management Plan
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SDGs	sample delivery groups
STL	Severn Trent Laboratories, Inc.
SI	site investigation
SSHO	Site Safety and Health Officer
SSHP	Safety and Health Plan
SVOCs	semivolatile organic compounds
TPH	total petroleum hydrocarbons
URS	URS Corporation
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOCs	volatile organic compounds

## 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP), in conjunction with the Field Sampling Plan (FSP), make up the Sampling and Analysis Plan (SAP), which is an integral part of the Remedial Action Management Plan (RAMP) for the former North Pacific Division (NPD) laboratory landfill removal action in Troutdale, Oregon. The purpose of the SAP is to ensure production of high quality data that meet project objectives and requirements, and to accurately characterize measurement parameters. The SAP provides protocols for collecting samples, measuring and controlling data, and documenting field and laboratory methods so that the data are technically and legally defensible. The SAP was prepared in accordance with the guidelines set forth by the U.S. Army Corps of Engineers (USACE) requirements.

The SAP has two major components: Part A – the FSP and Part B – this QAPP. The FSP presents the detailed scope of work associated with field activities (e.g., sample types and sampling locations) and specifies the procedures to be used for sampling and other field operations. The QAPP describes the analytical data quality objectives (DQOs), laboratory analytical procedures, quality assurance/quality control (QA/QC) procedures, and data quality evaluation criteria.

Sampling and analysis procedures for the field exploration are designed to be sufficient to satisfy the DQOs identified in Section 5 of the RAMP. This plan presents the analytical methods and associated QA/QC procedures selected to meet the project DQOs. The sampling and analysis procedures and DQOs are substantially the same as those used in the Site Investigation (SI) conducted previously at the landfill to ensure data comparability (URS 2002).

## **2.0 ANALYTICAL DATA QUALITY OBJECTIVES**

The purpose of the field activities at the former NPD laboratory site (the Site) is to complete a consistent sampling and analysis scope that can be used to characterize the contents of the landfill in order to arrange for appropriate disposal and to confirm the successful removal of landfill contents. Soil and waste samples will be collected for the following purposes:

- To collect the analytical data required to characterize the soil and waste in the landfill; and
- To confirm that all soil impacted by the presence of the landfill has been removed from the site.

### **2.1 CHEMICALS OF POTENTIAL CONCERN**

Confirmation soil samples will be collected and analyzed for chemicals of potential concern (COPCs). For the landfill removal action, the COPCs have been identified as benzo(a)pyrene and arsenic.

Concentrations of COPCs detected during laboratory analysis will be compared to 2002 EPA Region 9 Preliminary Remediation Goals (PRGs) for industrial soil.

### **2.2 DATA QUALITY LEVELS**

The sampling and analysis program was developed to generate data to meet project objectives and support the conclusions made by the technical staff. A more detailed description of the sampling rationale and project DQOs can be found in Section 5 of the RAMP. The quality control program associated with this approach and documented in this QAPP has been developed to address these uncertainties.

Two levels of data quality and analysis are applicable for this project:

- Screening-level data; and
- Definitive data.

#### **2.2.1 Screening Level Data**

A photoionization detector (PID) will be used to screen soil samples for the presence of volatile organic vapors. A discussion of field measurement quality assurance is presented in Section 3 of this QAPP.

#### **2.2.2 Definitive Level Data**

Definitive data will be generated to characterize landfill contents for disposal, determine the presence and concentration of COPCs at the Site, and to compare the detected concentrations to

regulatory screening criteria. To generate data of sufficient quality for these uses, the following approach will be followed:

- The laboratory will be validated by the U.S. Army Corps of Engineers (USACE);
- Methods approved by the U.S. Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (DEQ) will be used. Quality control samples and procedures will be used by the laboratory for analysis as specified in Sections 4 through 6 and Appendix B of the *Final Management Plan* (FMP), *Site Investigation* (SI) (URS 2001);
- The laboratory will provide EPA CLP-like data reports for all analyses requiring definitive data. The complete data report and documentation must be sufficient to perform data validation if required; and
- Data quality review and validation will be performed on the analytical data according to the procedures specified in Section 10.

## **2.3 ANALYTICAL METHODS**

Samples collected during the former NPD laboratory landfill removal action will be analyzed according to EPA-approved methods. The analytical methods to be performed for the landfill removal action are presented in Section 5. The laboratory's standard operating procedures (SOPs) must be in compliance with the USACE *Engineering Manual EM 200-1-3*, Appendix I (USACE 2001), with modifications where appropriate. All method modifications must be documented and approved by the USACE.

Sewern Trent Laboratories located in Fife, Washington will perform all laboratory analyses.

## **2.4 ANALYTICAL METHOD DETECTION LIMITS AND METHOD REPORTING LIMITS**

Sensitivity requirements for all methods and matrices are driven by the DQOs. Laboratory data for the COPCs will be compared to applicable screening criteria as listed in RAMP Table 5.1. Therefore, method reporting limits (MRLs) will be less than the applicable matrix-specific screening criteria. Method detection limits (MDLs) and MRLs are defined below.

Values reported below the MRL but above the MDL and flagged as estimated (J) may be used as semi-quantitative data points. However, when there are no analytes reported below the MRL, the data value used for comparison will be the MRL.

#### **2.4.1 Method Detection Limits**

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs are determined from analysis of a sample in a given matrix containing the analyte (Appendix B of 40 CFR 136).

#### **2.4.2 Method Reporting Limits**

The Method Reporting Limit (also called the Practical Quantitation Limit [PQL] by Severn Trent Laboratories) is a threshold value below which the laboratory reports a result as non-detected. It may be based on project-specific criteria, regulatory action levels, or sensitivity capability of method and instrument. MRLs are adjusted based on the sample matrix and any necessary sample dilutions. The MRL represents the value for which the laboratory has demonstrated the ability to reliably quantitate target analytes within prescribed performance criteria for the method performed. Analytes whose concentrations fall below the MRL will be considered estimated. The laboratory MRLs are presented along with corresponding COPC cleanup levels in Attachment A. In no case is the laboratory MRL greater than one-half of the corresponding COPC cleanup level.

### **3.0 METHODS AND QUALITY CONTROL FOR FIELD ACTIVITIES**

This section describes field measurement procedures, sample handling, and coordination procedures between the sampling team and the analytical laboratory. Detailed sampling procedures are presented in the accompanying FSP.

#### **3.1 FIELD MEASUREMENT METHODS**

A PID will be used to perform headspace screening on the soil samples. The PID will be used and calibrated daily according to the manufacturer's instructions.

#### **3.2 FIELD MEASUREMENT INSTRUMENT CALIBRATION PROCEDURES**

The calibration and general maintenance of field instruments will be the responsibility of the Field Sampling Technician. All calibration procedures and measurements will be made in accordance with manufacturer's specifications. Field instruments will be checked and calibrated before their use on Site, and batteries will be charged and checked daily.

Instrument calibration will be conducted at the beginning of each workday, and if necessary, through the course of the day, in accordance with SOPs. A final calibration will be conducted at the end of the day after the last field sample has been analyzed. Special attention will be given to instruments that may drift with change in ambient temperature or humidity. A three-point initial calibration will be conducted to the instrument being used, if applicable. One-point calibrations will be conducted thereafter. If an instrument is found to be out of compliance during a calibration, sampling personnel may be required to re-analyze samples collected subsequent to the failed recalibration.

Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it should not be used until repaired. Equipment that cannot be repaired or recalibrated will be replaced.

All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in an active field logbook. Logbook entries regarding the status of field equipment will contain, but will not necessarily be limited to, the following information:

- Date and time of calibration;
- Name of person conducting calibration;
- Type of equipment being used or serviced and identification (make and model);
- Reference standard used for calibration;
- Calibration and/or maintenance procedure used;

- Adjustments made based on calibration results; and
- Other pertinent information (e.g., operational problems such as drift).

### **3.3 SAMPLE HANDLING, CONTAINERS, PRESERVATION, AND HOLDING TIMES**

Sample containers, preservation, and holding times are summarized in Table 3-1 in the FSP. Samples will be collected in glass containers with screw-type lids to ensure adequate sealing. The lids of the containers will have Teflon<sup>®</sup> inserts to prevent sample reaction with the lid and to improve the quality of the seal.

Commercially available pre-cleaned containers will be used. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier, and bottle wash analysis results can be reviewed. The bottle wash certificate documentation will be archived in the permanent project file.

Before making shipments to the field, the project laboratory will add the required preservatives to the sample bottles, if necessary. Sample preservation procedures are used to maintain the character of analytes as sampled (i.e., representative concentrations and/or speciation in situ) during storage and shipment. Regardless of the nature of the sample, absolute stability for all constituents cannot be achieved. Preservation techniques, such as pH control and refrigeration, may retard physiochemical and biochemical changes. As a general rule, analyzing the sample as soon as possible is the best way to minimize physicochemical and biochemical changes.

Samples will be placed in the appropriate sample container and refrigerated (on ice in a cooler) immediately upon sample collection. The samples will be transferred to the project laboratory as soon as possible using standard chain-of-custody procedures, as described in the FSP. Based on the potential levels of contaminants, samples for all analyses will be hand-delivered or shipped as environmental samples. Upon receipt at the project laboratory, a cooler receipt form will be filled out to document sample condition. The laboratory must fax the chain-of-custody and cooler receipt forms to the contractor within 8 hours of sample receipt. The laboratory will make every effort to meet all specified holding times.

### **3.4 COORDINATION WITH ANALYTICAL LABORATORY**

Team members will work closely with the project laboratory to ensure that samples are handled and analyzed following the procedures described in this QAPP. A schedule of field work and sampling will be established approximately 2 weeks before commencement of field work. Each day that samples are shipped to the laboratory, a designated team member will contact the laboratory to confirm that samples have been received.

The project laboratory will contact the Project Chemist after it is suspected that reanalysis of a sample by the laboratory is unsuccessful due to matrix interference. The Project Chemist will immediately notify the Cherokee Project Manager, who will notify the USACE Project Manager.

## **4.0 QUALITY CONTROL SAMPLES**

Field QC and laboratory QC samples will be employed to evaluate data quality. QC samples are controlled samples introduced into the analysis stream, whose results are used to assess data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of QC sample, collection and analysis frequency, and evaluation criteria are described in this section. Collection frequencies for field QC samples are summarized in Table 4-1. Laboratory reporting limits and regulatory screening values are presented in Attachment A. Required QC criteria (including frequency and corrective action) and laboratory performance-based QC limits are listed in Appendices B and C, respectively of the FMP QAPP.

QC procedures for the project laboratory will be consistent with the requirements described in this QAPP. This document defines and adds procedures and QC elements that an analytical method may leave ambiguous. The laboratory will be required to conduct all QC measurements for this project on samples from and within batches of samples for this project alone. In other words, no other project samples will be used with samples from this project for assessment of data quality.

### **4.1 FIELD QUALITY CONTROL SAMPLES**

Field QC is accomplished through the analysis of controlled samples that are introduced to the laboratory from the field. Rinsate blanks, trip blanks, field duplicates, and temperature blanks will be collected and submitted to the project laboratory to provide a means of assessing the quality of data resulting from the field sampling program.

#### **4.1.1 Rinsate Blanks**

Rinsate blanks are collected to determine the potential for cross-contamination of samples during collection when improperly cleaned field equipment is used. Rinsate blanks are used to assess the quality of the decontamination process and to quantify COPC contaminants that might have been transferred. If non-dedicated sampling equipment is used, rinsate blanks will be collected and analyzed at the rate of 5 percent of all soil samples submitted to the laboratory. If dedicated or disposable sampling equipment is used, no rinsate blank is required.

Rinsate blanks will consist of laboratory-provided, analyte-free, deionized water collected from the final rinse of the sampling equipment after completion of the decontamination procedures described in Section 2.5 of the FSP. Blank sample collection frequency is listed in Table 4-1.

All rinsate blanks will be submitted blind to the laboratory with sample numbers that are indistinguishable from primary samples. Blank samples will be analyzed for the same parameters as those associated field samples. The concentrations of analytes detected in the blanks will not be subtracted from the sample containers.

#### **4.1.2 Trip Blanks**

Trip blanks will be used to check for procedural contamination, cross-contamination, and contamination during shipment and storage of solid samples collected for VOC analysis. One trip blank will be submitted to the project laboratory for each cooler containing soil samples for VOC analysis. A trip blank prepared with sodium bisulfate preservative will be included when a cooler contains VOA samples collected using the low concentration procedure of Method 5035. A trip blank prepared with methanol will be included when a cooler contains only VOA samples collected using the high concentration procedure of Method 5035. The sodium bisulfate preservative trip blanks will consist of a sample vial containing sodium bisulfate with no soil added. The methanol preservative trip blanks will consist of a sample jar containing muffled sand and methanol. At no time after their preparation are the sample containers to be opened until they are returned to the laboratory. Each trip blank will be inspected for overall condition, which will be noted in the field notebook. Each trip blank will be assigned a number to identify the cooler it accompanies, which will be recorded in the field logbook and on the chain-of-custody form. Trip blanks will be placed in the cooler with the first environmental sample collected. The self-sealing bag containing the trip blanks will be left open in the cooler throughout the sampling day.

The trip blanks will be indistinguishable from the other samples to the extent possible, and will be prepared using sample containers and labels identical to those used for the primary samples. The concentrations of analytes detected in the trip blanks will not be subtracted from the sample concentrations.

#### **4.1.3 Field Duplicates**

Field duplicate samples are used to check for sampling and analysis reproducibility. Field duplicates will be submitted to the project laboratory at a frequency of 10 percent of the field samples for each analytical method. Field duplicate samples should be collected from areas most likely to be contaminated. Field duplicate samples will be collected in conjunction with and analyzed by the same methods as the primary samples. Control limits for field duplicate precision are 50 percent relative percent difference (RPD) for soil samples.

Field duplicates will be submitted blind to the laboratory, with sample numbers that are indistinguishable from primary samples. Calculation and reporting of the RPD for field duplicates are described in section 7.1

#### **4.1.4 Temperature Blanks**

Temperature blanks are used to measure cooler temperatures upon receipt of the coolers at the laboratory. One temperature blank will be prepared and submitted to the project laboratory with each cooler. The temperature blank will consist of a sample jar containing water, which will be packed on ice in the cooler in the same manner as the rest of the samples and labeled "temperature blank".

## **4.2 LABORATORY QUALITY CONTROL SAMPLES**

Laboratory QC is accomplished by analyzing initial and continuing calibration samples, method blanks, surrogate spikes, matrix spike (MS)/matrix spike duplicate (MSD) pairs, laboratory control samples (LCS), and laboratory duplicate samples. Project-specific QC criteria (including frequency, QC limits, and corrective actions) are presented in Appendix B of the FMP QAPP. The criteria presented in Appendix B of the FMP QAPP are derived from USACE guidance and the referenced methods. The laboratory analysts will process the data, and the Laboratory QA Manager will review data for overall reasonableness and transcription or calculation errors, in compliance with the QC criteria presented in these tables.

### **4.2.1 Initial and Continuing Calibration Standards**

Laboratory instrument calibration and maintenance requirements are discussed in Section 6.

### **4.2.2 Method Blanks**

Method blanks are used to check for laboratory and reagent contamination, instrument bias, and accuracy. Laboratory method blanks will be analyzed at a minimum frequency of 5 percent or one per analytical batch for all chemical parameter groups.

QC criteria require that minimum contamination be detected in the blank(s). If a chemical is detected, the action taken will follow the criteria established by this QAPP. Blank samples will be analyzed for the same parameters as the associated field samples. The concentrations of analytes detected in the method blanks will not be subtracted from the sample concentrations.

### **4.2.3 Surrogate Spikes**

The accuracy of an analytical measurement may be evaluated by using surrogate spikes. Surrogate compounds are compounds not expected to be found in environmental samples. However, they are chemically similar to several compounds analyzed in the methods, and behave similarly in extracting solvents. Samples for organic compound analysis will be spiked with surrogate compounds consistent with the requirements described in the laboratory SOPs.

Percent recovery of surrogates is calculated concurrently with the analytes of interest. Because sample characteristics will affect the percent recovery, the percent recovery is a measure of accuracy of the overall analytical method on each individual sample.

### **4.2.4 Laboratory Control Samples**

Laboratory control samples (LCSs) are used to monitor the laboratory day-to-day performance of routine analytical methods, independent of matrix effects. LCSs are prepared by spiking reagent water with standard solutions that contain the same compounds used in establishing instrument calibration. Spiking levels will be between the low- and mid-level calibration standards used for the primary samples. LCSs are extracted and analyzed with each batch of samples. Results are

compared on a per-batch basis and are used to evaluate the laboratory's performance for accuracy. LCSs may also be used to identify any background contamination of the analytical system that may lead to the reporting of elevated concentration levels or false-positive measurements.

#### **4.2.5 Matrix Spike/Matrix Spike Duplicates**

MS/MSD sample pairs are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy and precision of the analysis. For MS or MSD samples, known concentrations of analytes are added to environmental samples. The samples are then processed through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery of the known spiked amount (and RPD for MS/MSD).

Spiked samples will contain all the target compounds required by the CLP. Spiking concentrations for all MS/MSD sample analyses will be at concentrations in the middle of the calibration range that is used to analyze the primary sample.

Because MS/MSD samples are used to measure the matrix interference of a specific matrix, only samples from this investigation will be analyzed as MS/MSD. The MS/MSD samples will be analyzed for the same parameters as the associated field samples in the same QC analytical batch. Poor MS/MSD recoveries may not be attributed to matrix interference until the laboratory re-prepares the samples, with accompanying cleanup procedures and re-analysis, and the results indicate similarly poor recoveries.

Generally, a specific sampling location will be used to collect field QC samples. However, it may not be possible to collect MS/MSD samples for all analyses at the same sampling locations because of the limited volume of material available. In those instances, MS/MSD samples for various analyses will be collected from different locations. Additionally, samples for MS/MSD analyses will be designated in the field but will not be collected from locations with potentially high concentrations of target analytes that may mask the added spike compounds. Required laboratory QC criteria and corrective actions for MS/MSD samples are presented in Appendix B of the FMP QAPP.

#### **4.2.6 Laboratory Duplicate Samples**

Precision of the analytical system is evaluated by analyzing MS/MSD pairs and laboratory duplicates. Laboratory duplicates are two portions of a single homogenous sample analyzed for the same parameter. Laboratory duplicates will be prepared and analyzed with project samples being analyzed for metals and other inorganic analytes. If a sample contains high native concentrations of organic compounds, a laboratory duplicate (instead of MSD) should be analyzed.

**Table 4-1**  
**Field Quality Control Sample Collection Summary**

Sample Type	Frequency
Rinsate Blanks	5 percent
Temperature Blanks	1/cooler
Trip Blanks	1/cooler for VOC analyses (per matrix)
Reagent Trip Blanks (preservatives)	1/cooler for VOC analyses (per matrix)
Field Duplicates	10 percent

## 5.0 METHODS AND QUALITY CONTROL FOR LABORATORY ACTIVITIES

This section describes the analytical procedures to be used for project laboratory measurements. The analytical methods and associated QA/QC procedures were selected based on consideration of the project DQOs.

### 5.1 ANALYTICAL METHODS

The analytical methods, calibration procedures, and QC measurements and criteria are based on current analytical protocols in the following documents:

- *EPA SW-846 Test Methods for Evaluation of Solid Waste* (USEPA 1998);
- *USACE Engineering Manual EM 200-1-3, Appendix I* (USACE 2001); and
- Washington State Department of Ecology, *Analytical Methods for Petroleum Hydrocarbons*, ECY 97-602 (June 1997).

Samples will be analyzed using the methods described in Sections 5.1.1 through 5.1.7 below. Table 3-1 in the FSP provides requirements for sample containers, preservation, holding times, and analytical methods. Refer to Appendix B of the FMP QAPP for a complete description of required QC criteria for each method.

#### 5.1.1 Volatile Organic Compounds

CLP TCL VOCs will be analyzed by SW-846 methods including Method 8260B for analysis, and Method 5035 for preparation of solid samples. The CLP TCL is the same list of compounds analyzed for during the SI. These methods are used to determine low-level concentrations of VOCs in soil. Soil samples will be preserved in the field with methanol or sodium bisulfate. Soil samples anticipated to contain VOCs at concentrations less than 200 ppb will be preserved in the field with sodium bisulfate. Soil samples anticipated to contain VOCs at concentrations greater than 200 ppb will be preserved in the field with methanol. A purge-and-trap system is used to concentrate the volatile compounds prior to analysis by gas chromatography/mass spectrometry (GC/MS) with an ion trap (Table B-1 in Appendix B of the FMP QAPP).

#### 5.1.2 Semivolatile Organic Compounds

CLP TCL SVOCs will be analyzed by SW-846 methods including Method 8270C for analysis and Method 3550B for preparation of solid samples. The CLP TCL is the same list of compounds analyzed for during the SI. These methods are used to determine low-level concentrations of SVOCs in extracts prepared from all types of matrices. Soil samples are extracted with methylene chloride and acetone using a heated ultrasonic bath for extraction and a GC/MS for analysis (Table B-2 in Appendix B of the FMP QAPP).

### **5.1.3 Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)**

CLP TCL organochlorine pesticides and CLP TCL PCBs will be analyzed by SW-846 methods including Method 8081A for chlorinated pesticides and Method 8082 for PCBs. The CLP TCL is the same list of compounds analyzed for during the SI. Method 3550B will be used to prepare solid samples. These methods provide procedures for determining low-level concentrations of certain chlorinated pesticides and PCBs. Pesticides are extracted with hexane and PCBs with a hexane:acetone mix on a shaker table. The extracts are then analyzed by GC equipped with a dual electron capture detector (ECD) (Tables B-3 and B-4 in Appendix B of the FMP QAPP).

### **5.1.4 Metals**

CLP TAL metals, including strontium and uranium, will be analyzed by SW-846 methods including Method 6010B (inductively coupled plasma [ICP]) and Method 6020 (inductively coupled plasma/mass spectrometry [ICP/MS]). The CLP TAL is the same list of compounds analyzed for during the SI. Method 3051 will be used for preparation of solid samples. Mercury will be prepared and analyzed in accordance with SW-846 method 7471.

These methods provide procedures for the preparation, operation, tuning, optimization, and analysis of samples for metals in solids (Tables B-5 and B-6 in Appendix B of the FMP QAPP).

### **5.1.5 Total Cyanide**

Total cyanide in solid samples will be analyzed by SW-846 Method 9012A. Method 9013 will be used for preparation of solid samples. These methods provide the procedure for analysis of total cyanide in most solid matrices. The analysis uses a strong acid distillation and pyridine-barbituric acid colorimetric titration (Table B-7 in Appendix B of the FMP QAPP).

### **5.1.6 Toxicity Characteristic Leaching Procedure**

Waste characterization samples determined to contain total consistent concentrations greater than 20 times the maximum concentration of contaminants for the toxicity characteristic as defined in 40 CFR 261.20 Subpart C Characteristics of Hazardous Waste will be extracted by SW-846 Method 1311 and the constituent concentration in the extract determined appropriate method.

### **5.1.7 Petroleum**

Petroleum compounds will be analyzed by Method NWTPH-Dx. This method provides a procedure for the quantitative and qualitative analyses of semivolatile petroleum products in soil and water. The samples are extracted with methanol, and a portion of the extract is injected directly into a GC with flame ionization detector (FID) (Table B-8 in Appendix B of the FMP QAPP).

## **5.2 MODIFICATION OF STANDARD METHODS**

Severn Trent Laboratories uses a modification of Method 3550B to extract semivolatile organic analytes from soils and solids. The modification includes the use of a heated ultrasonic bath. Severn Trent Laboratories is validated for semivolatile soil extractions by the USACE based on this modified procedure.

## **5.3 LABORATORY PERFORMANCE**

The laboratory selected for this project is USACE validated (see Appendix D of the FMP QAPP). The laboratory's in-house statistical control limits, based on historical data, demonstrate its ability to meet project-specific control limits on a routine basis. Laboratory procedures will be implemented according to the laboratory's QA plans and SOPs. In addition, the laboratory will be required to meet the QA/QC standards established in this QAPP.

The laboratory will ensure the quality of results by maintaining an integrated quality assurance system of activities involving the planning, implementation, assessment, reporting, and quality improvement of data. These activities will be performed or facilitated by the Laboratory QA Manager and will include: (1) performance of periodic audits (system and technical); (2) participation in proficiency testing programs/interlaboratory comparisons; (3) routine analysis of certified reference materials or second source reference materials; and (4) monitoring method performance (sensitivity, precision, and bias) through an evaluation of the MDL or MDL check sample, and batch QC sample (method blank [MB], LCS) control ranges/changes.

The selected laboratory must ensure that all possible procedures for achieving minimum reporting limits are applied. These procedures will include sample cleanup, increased aliquot size, and concentration of extracts. In addition, the laboratory will report (as estimated) all detected compounds whose concentrations are below the MRL but above the MDL. If dilutions are necessary to bring individual target analytes within the calibration range, these analytes will be reported from the dilution while the remaining analyte results will be reported from the nondiluted analytical run.

The laboratory will demonstrate that it tried cleanup procedures or methods of standard additions, as recommended in the methods, to deal with suspected matrix effects. Sample dilution may be used to deal with matrix interferences only after extensive cleanups have been tried and have been unsuccessful.

If target analytes in LCS samples are out of control limits, corrective action will be taken. Initially, the effect the QC failure has on the samples will be evaluated. Regardless of the results of this assessment, the laboratory will take steps to find the source of the problem and correct it. Typically, the laboratory will reanalyze the LCS for the failed analytes only. If the second analysis fails, the LCS, method blank, and all associated samples of the batch will be re-prepared and reanalyzed for the failed analytes only. When there are multiple target analytes (more than

five), sporadic marginal failures of a few target analytes included in the LCS may be acceptable without requiring reanalysis of the entire batch.

USACE guidance states that the method blank is acceptable if "the concentration of all target analytes is below one-half the MRL for each target analyte, or less than 5 percent of the regulatory limit associated with that analyte, or less than 5 percent of the sample results for the same analyte, whichever is greater." The laboratory will be required to comply with the USACE guidance for analysis of the method blank as follows:

- If an analyte is found only in the method blank, but not in the batch samples, no further corrective action is necessary. Steps should be taken to find and reduce or eliminate the source of this contamination in the method blank.
- If an analyte is found in the method blank at concentrations that exceed criteria, and in some or all of the other batch samples, the laboratory shall reanalyze (within the holding times) the method blank and any samples containing the same contaminant.
- If the contamination remains at concentrations that exceed criteria, the laboratory shall re-prepare and reanalyze (within the holding times) the contaminated samples, a new method blank, and batch-specific QC samples.
- If holding times are exceeded before reanalysis occurs, the laboratory must notify the Project Chemist immediately. The Cherokee Project Manager will decide if reanalysis or re-extraction outside of holding times should be undertaken.

Laboratory requirements for compound identification are prescribed within the SW-846 analytical methods used. In some organic methods, the information is included directly within the method used (e.g., GC/MS Methods 8260B, 8270C), or this information is referenced to a general EPA SW-846 method (such as 8000B) that outlines procedures applicable to several chromatographic methods. Laboratory SOPs present procedures required to establish retention time windows (window width and location) for each target analyte for each chromatographic column employed in the analysis.

Laboratory requirements for compound confirmation are prescribed within the EPA SW-846 analytical methods employed. For GC/MS methods, compound confirmation is obtained from the mass spectrum following specified procedures included within the methods, and no additional measures are needed. For GC methods, EPA SW-846 procedural options are presented in Method 8000B, Section 7.9. The USACE guidance recommends in preferential order the use of the GC/MS or other analytical technique (if applicable), a dissimilar column (if available), or a second detector as a means for confirmation. When using a secondary column, Method 8000B Section 7.9 states that the analysis should meet the QC criteria (for example, for calibration or retention time). The USACE guidance further recommends that if quantitative results are to report from the secondary column (i.e., when interferences are noted on the primary column), additional documentation must be furnished. This documentation must show that the same

procedures for calibration and batch QC that are applied to the primary column are applied and successful on the secondary column.

When confirmed, the agreement between the primary and secondary columns (or detectors) is compared to evaluate method performance and decide the value to report (if applicable). The difference between the results is calculated as the RPD for comparability purposes only. These RPD values are generally not used to determine presence/absence of the target analyte. Presence/absence is determined by the signal being present on both columns. When disparity in the results occurs, the laboratory must review the chromatograms to evaluate potential sources of error (such as overlapping peaks or matrix interference). When no evidence of interference is found, the larger of the values should be reported to ensure that any decisions made based on the data are conservative with regard to the environment.

The selected methods and QC requirements listed in this section are sufficient to meet the project objectives. While a best effort will be made to achieve the project objectives, there may be cases in which it is not possible to meet the specified goals. Any significant limitation to data quality caused by analyses that fail to meet the data quality indicators specified in this QAPP will be identified and brought to the attention of the USACE Technical Leader.

## **5.4 QUALITY CONTROL**

The following procedures will be instituted to ensure that data to be used in decision making comply with QC criteria presented in this QAPP. The following procedures will be part of the overall project QA/QC activities:

- Data review will be performed on 100 percent of all analytical data. Data validation will be performed on 10 percent of all the analytical data.
- A laboratory monitoring program will be employed to institute corrective actions in laboratory procedures, as necessary, to provide defensible, quality data.

The laboratory will receive copies of the RAMP, including the QAPP. Approximately 1 week prior to the commencement of field work, a telephone conference call will be conducted that will include participation by key project personnel such as laboratory representatives, the Cherokee Project Manager, and the Project Chemist. The USACE Project Manager may also choose to participate. The purpose of the telephone conference call will be to ensure that the field sampling program and required analytical procedures are clear to the laboratory, that the laboratory is prepared to receive and analyze the project samples, and that all personnel involved understand how data acquisition will be accomplished.

The laboratory will be required to prepare briefing reports that will be forwarded to Cherokee. The briefings will include numbers of samples received, conditions of samples, requested analytical methods, and any other pertinent information regarding sample receipt. In addition, the briefings will provide information related to laboratory QC issues, such as matrix effects or

surrogate recoveries. The purpose of these briefings is to institute corrective actions as soon as they arise to ensure that the final data packages provide reliable, accurate, and defensible data.

## **6.0 LABORATORY INSTRUMENT CALIBRATION**

Instrument calibration will be in compliance with EPA-approved methods, this QAPP, and the manufacturer's instructions. General requirements are discussed below.

### **6.1 STANDARD SOLUTIONS**

A critical element in the generation of quality data is the purity/quality and ability to trace the standard solutions and reagents used in the analytical operations. To ensure the highest purity possible, the laboratory will obtain all primary reference standards and standard solutions from the National Institute of Standards and Technology<sup>1</sup>, or other reliable commercial source. The standards will be either certified by NIST or traceable to NIST standards. The laboratory will maintain a written record of the supplier, lot number, purity/concentrations, receipt/preparation date, name of the analyst, method of preparation, expiration date, and all other pertinent information for all standards, standard solutions, and individual standard preparation logs.

Standard solutions will be validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard solution using another standard solution prepared at a different time or obtained from a different source. Stock and working standard solutions will be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or changes in concentrations. Care will be exercised in the proper storage and handling of standard solutions, and all containers will be labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation). Reagents will be examined for purity by subjecting an aliquot or sub-sample to the corresponding analytical method as well.

### **6.2 BALANCES**

The laboratory will calibrate analytical balances annually according to manufacturer's instructions and have a calibration check before each daily use by laboratory personnel. All balance calibrations will use Class 1 or S weights and will be within a range appropriate to the sample mass. Acceptance criteria for top-loading balances will be as defined in ASTM Standard D 4753 and 0.1 percent for analytical balances. Annual calibrations and calibration checks will be documented in appropriate hardbound logbooks with pre-numbered pages.

### **6.3 REFRIGERATORS**

The laboratory will monitor all refrigerators for proper temperature by measuring and recording internal temperatures on a daily basis using National Institute of Standards and Technology (NIST)-certified or NIST-traceable thermometers. At a minimum, thermometers used for these measurements will be calibrated annually according to manufacturer's instructions. Refrigerators will be maintained at 4°C/+2°C, and freezers at -10°C to -20°C. Refrigerator and freezer temperatures will be documented in appropriate hardbound logbooks with pre-numbered pages.

## **6.4 VOLUMETRIC MEASUREMENTS**

Before use, volumetric glassware or other laboratory ware will be inspected for cracks or damages. Eppendorf-type pipettes will be verified (weekly, at a minimum) at the volume to be used or at two different volumes that bracket the range of use. Fixed volume Eppendorf-type pipettes will be verified monthly. All non-standard laboratory ware used to measure the initial sample volume or the final volume of the extracts/digestates will be verified to be accurate within 3 percent. Each calibration check will be documented in appropriate hardbound logbooks with pre-numbered pages.

## **6.5 WATER SUPPLY SYSTEM**

The project laboratory will maintain an appropriate water supply system that is capable of furnishing American Society for Testing and Material (ASTM) Type II polished water to the various analytical areas. ASTM Type I or equivalent water should be used for trace metal analysis.

Initial calibration blanks and continuing calibration blanks will be used to document that the laboratory water supply system produces water that is free of the analytes of concern at the level of concern for the project. Method blanks will be used to ensure that none of the reagents used for the requested analyses are contaminated with the analytes of concern.

## **6.6 LABORATORY INSTRUMENTS**

As stated in laboratory SOPs, calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity required to meet project-specific objectives. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified, and at the QC frequency specified in the laboratory SOPs.

The calibration history of the fixed laboratory instrumentation is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

## 7.0 ANALYTICAL DATA QUALITY INDICATORS

The methods for the NPD laboratory landfill removal action have been selected to ensure that the accuracy and precision of the data will be sufficient and that the data will be useful for identifying and quantifying the specified analytes at the Site.

The data quality indicators presented in this section are: precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity. Table 7-1 presents a summary of QC samples and parameters that will be used to evaluate data quality. Project-specific QC criteria for laboratory analyses are summarized in Appendix B of the FMP QAPP.

**Table 7-1**  
**Parameters Used to Evaluate Data Quality**

Data Quality Indicator	QA Parameter
Precision	Field Duplicate Blank spike duplicate Laboratory duplicate Matrix Spike Duplicate
Accuracy/Bias	Matrix Spike Surrogate spike Initial calibration standards and blanks Continuing calibration standards and blanks Trip blank Rinse blank Method blank
Representativeness	Trip blank Method blank Rinse blank Chain-of Custody Holding times and preservation status
Comparability	Method detection limits Method reporting limits Sample collection methods Laboratory analytical methods
Completeness	Data qualifiers Laboratory deliverables Requested/reported valid results
Sensitivity	Method detection limits Method reporting limits

## 7.1 PRECISION

Precision is defined as the degree of agreement between or among independent, similar, or repeated measures. Precision is expressed in terms of analytical variability. For this project, analytical variability will be measured as the RDP or coefficient of variation between analytical laboratory duplicates and between the MS and MSD analyses. Monitoring variability will be measured by analysis of blind field replicate samples.

Precision will be calculated as the RPD as follows:

$$\text{RPD(\%)} = \frac{|S-D|}{(S+D)/2} \times 100$$

where:

RPD = *Relative percent difference for compound i*  
S = *Analyte concentration in original sample*  
D = *Analyte concentration in duplicate sample*

The resultant RPD will be compared to criteria established by this QAPP, and deviations from these criteria will be reported. If the QAPP criteria are not met, the laboratory will supply a justification of why the limits were exceeded, and will implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and will comment on the effect of the deviations on reported data.

## 7.2 ACCURACY/BIAS

Accuracy, or bias, is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systematic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ excessively from the known concentration of the spike or standard.

Accuracy measures the bias in a measurement system and is difficult to measure for the entire data collection activity. Sources of error include the samples process, field contamination, preservation handling, sample matrix, sample preparation, and analysis techniques.

Accuracy will be calculated as percent recovery of analytes as follows:

$$\%R_i = (Y_i / X_i) \times 100\%$$

where:

$\%R_i$  = percent recovery for compound *i*

$Y_i$  = measured analyte concentration in sample *i* (measured minus original sample concentration)

$X_i$  = known analyte concentration in sample *i*

The resultant percent recoveries will be compared to acceptance criteria and deviations from specified limits will be reported. If the objective criteria are not met, the laboratory will supply a justification why the acceptability limits were exceeded, and will implement the appropriate corrective actions. Percent recoveries will be reviewed during data validation, and deviations from the specified limits will be noted; the effect on reported data will be commented upon by the data reviewer.

### 7.3 REPRESENTATIVENESS

Representativeness is the degree to which sample results represent the system under study. This component is generally considered during the design phase of a program. This program will use the results of all analyses to evaluate the data in terms of their intended use. Site sampling locations for this project are placed using a biased approach to maximize the likelihood of locating and identifying Site contamination, if present. Areas of apparent contamination have been selected to be representative of potential impacts from past activities. Representativeness will also be determined by evaluating hold time, sample preservation, and blank contamination. Samples with expired hold times, improper preservation, or contamination may not be representative.

### 7.4 COMPARABILITY

Comparability is the degree to which data from one study can be compared with data from historical studies at the Site, other similar studies, reference values (such as background), reference materials, and screening values. This goal will be achieved through using standard techniques to collect samples, EPA-approved methods to analyze samples, and consistent units to report analytical results. Data comparability also depends on data quality. Data of unknown quality cannot be compared.

### 7.5 COMPLETENESS

Completeness for usable data is defined as the percentage of the total data set minus the rejected or missing data compared to the total data set generated. Specifically, the basis for calculation of completeness is the total number of planned data results (number of samples x number of analyses x number of analytes) relative to the total number of valid results generated. Data are considered valid if they fulfill the DQO requirements established in the QAPP. When feasible, the amount of sample collected will be sufficient to reanalyze the sample, should the initial results not meet QC requirements. Because the number of sample aliquots that will be collected to measure each parameter exceeds that required for the analysis, thus allowing for reanalysis, 100

percent completeness is anticipated. Less than 100 percent completeness could result if sufficient chemical contamination exists to require sample dilutions, resulting in an increase in the project-required detection/quantitation limits for some parameters. Highly contaminated environments can also be sufficiently heterogeneous to prevent the achievement of specified precision and accuracy criteria. Therefore, the overall project target goal for completeness will be 98 percent for laboratory analyses. Quality data are data obtained in a sample batch for which all QC criteria were met. Completeness will be calculated as follows:

$$\text{Completeness (\%)} = \frac{V}{P} \times 100$$

Where:        V = Number of valid measurements  
               P = Number of planned measurements

Valid and nonvalid data (i.e., data qualified as "R" rejected) will be identified during data review and validation (Section 10.2).

## 7.6 SENSITIVITY

Sensitivity will be determined by reviewing MDLs and MRLs. The sensitivity of some of the analytical methods identified for this project is insufficient to allow comparison of all the target analytes to all the screening criteria presented in the table in Appendix A of the FMP QAPP. Screening criteria concentrations that are lower than the laboratory MRLs are highlighted in Appendix A.

The laboratory will be directed to report compounds detected below the MRL and above the MDL as detected estimated (J-flag). These estimated compound concentrations will be used, in addition to the fully quantitated concentrations, for comparison to screening criteria.

## **8.0 PREVENTIVE MAINTENANCE**

Manufacturers have established guidelines for preventive maintenance of their instruments and equipment. Preventive maintenance is implemented on a schedule based on the type and stability of the instruments and equipment, project-required accuracy, intended use, and environmental factors. Preventive maintenance minimizes down time and ensures the accuracy, precision, sensitivity, and traceability of data collected while using the instruments and equipment. Maintenance is conducted by trained technicians, using service manuals, or through service agreements with qualified maintenance contractors. Instruments and equipment that are identified to be out of calibration or malfunctioning are removed from operation until they are recalibrated or repaired. In addition, backup for instruments/equipment and critical spare parts are maintained to quickly correct malfunctions. Examples of typical equipment maintenance spare parts may include but are not limited to, filters, tubing, and fittings.

### **8.1 FIELD INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY**

Calibration of all equipment and instrumentation ensures that accurate and reliable measurements are obtained. All instruments and equipment used on the project are calibrated and adjusted to operate within manufacturer's specifications and with a frequency stipulated by the maintenance schedule or by analytical method. Instrument calibration will be conducted at the beginning of each workday and at midday in accordance with the instrument manufacturer's recommended procedures. A final calibration will be conducted at the end of the day after the last field sample has been analyzed. The initial calibration will include three calibration standards, if appropriate to the instrument being used. One-point calibrations will be conducted thereafter. In addition, one-point calibrations will be made when sampling conditions change, when sample matrices change, and/or if the instrument readings become unstable.

The PID used during the collection of soil samples will be factory serviced and calibrated before the project is initiated and will be field-checked daily in accordance with the manufacturer's instructions.

### **8.2 LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION**

The procedures for maintenance and calibration used by the analytical laboratory are included in their laboratory QA plan and analytical methods. All laboratory calibration standards must be traceable to the NIST or other primary standards. Methods and intervals of calibration are based on the type of equipment, stability characteristics, required accuracy, intended use, and environmental conditions. Section 6 provides requirements for laboratory instruments. The tables in Appendix B of the FMP QAPP provide additional QC criteria required for laboratory instrument calibration.

### **8.3 CALIBRATION AND MAINTENANCE RECORDS**

Calibration and maintenance schedules and records are maintained for the laboratory's instruments and Cherokee-owned or Farallon-owned field equipment. Both equipment and equipment records are located in a controlled-access facility when not in use. This is done to minimize equipment damage, theft, and tampering that may jeopardize either field or laboratory measurements, and ultimately, data quality.

## **9.0 CORRECTIVE ACTIONS**

The project plans, SOPs, and training establish the baseline for field quality control. The ultimate responsibility for maintaining quality throughout the NPD landfill removal action rests with the Cherokee Project Manager. The day-to-day responsibility for ensuring the quality of field and laboratory data rests with the Project Chemist, Project CQC System Manager, or QA/QC Designee, Sampling Technician and the Laboratory QA Manager.

Results of QA reviews and audits typically identify the requirement for a corrective action. The Project CQC System Manager is responsible for reviewing all audit and nonconformance reports to determine areas of poor quality or failure to adhere to established procedures. The Cherokee Project Manager is responsible for evaluating all reported nonconformances, determining the root cause, conferring with the CQC System Manager/Designee on the steps to be taken for correction, and ensuring that the corrective action is developed and scheduled. Corrective action measures are selected to prevent or reduce the likelihood of future occurrences and address the root causes to the extent identifiable. Selected measures are appropriate to the seriousness of the nonconformance and are realistic in terms of the resources required for implementation.

Any nonconformance with the established QC procedures will be expeditiously identified, corrected, and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

In summary, corrective action involves the following steps:

- Discovery of a nonconformance;
- Identification of the responsible party;
- Determination of root causes;
- Planning and scheduling of corrective/preventive action;
- Review of the corrective action taken; and
- Confirmation that the desired results were produced.

### **9.1 FIELD CORRECTIVE ACTION**

The Field Superintendent and Sampling Technician will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, and other procedures will be checked for completeness. Where procedures are not in compliance with the established protocol, the deviations will be field documented and reported to the CQC System Manager.

Examples of field nonconformances include, but are not limited to, the following:

- Items provided by a subcontractor supplier that do not meet the contractual requirements;
- Errors made in following work instruction, or improper work instruction;
- Unforeseen or unplanned circumstances that result in services that do not meet quality/contractual/technical requirements;
- Unapproved or unwarranted deviations from established procedures;
- Nonvalidated or nonverified computer programs;
- Sample chain-of-custody missing or deficient; and
- Data falling outside established objective criteria.

Corrective actions will be defined by the Sampling Technician CQC System Manager and documented. Problems that require corrective action are documented by the use of a corrective action report. Upon implementation of the corrective action, the Sampling Technician CQC System Manager will provide the CQC System Manager with a written memo documenting field implementation. The memo will become part of the project file.

## **9.2 LABORATORY CORRECTIVE ACTION**

The laboratory QA managers will review the data generated to ensure that all samples have been analyzed as specified in this QAPP (Appendices A and B of the FMP QAPP). Percent recoveries of surrogates and spiked analytes from LCS samples and MS samples will be evaluated for accuracy. RPDs for laboratory duplicate or MSD samples will be evaluated for precision. Corrective action requirements for noncompliant data are presented in Appendix B of the FMP QAPP and in laboratory SOPs.

The Laboratory Project Manager will fax the chain-of-custodies and cooler receipt forms to Cherokee within 8 hours of sample receipt. Cherokee will be notified immediately if discrepancies occur between the contracted analyses and the analyses listed on the chain-of-custody forms. The laboratory will contact the Project Chemist to discuss noncompliant data sets within 72 hours of first discovering that any analysis failed to meet the required data quality criteria. If the analyses cannot produce data sets that are within control limits, the USACE Technical Leader will be notified. At a minimum, corrective actions are necessary if any of the following occur:

- Initial calibration verification and continuing calibration verification do not meet QC criteria;
- Any changes in the MDL or MRL occur;

- Blanks contain contaminants at concentrations greater than one-half the MRL for any target analyte (refer to section 5.3);
- The QC data are outside the acceptance windows for precision and accuracy established for LCS;
- Undesirable trends are detected in surrogate, MS, or LCS recoveries;
- Undesirable trends are detected in RPD for MS/MSD or laboratory duplicates; or
- The Laboratory QA Manager detects deficiencies during internal or external audits.

If laboratory personnel identify any nonconformance in analytical methodologies or QC sample results, corrective actions will be implemented immediately. Corrective action procedures will be handled initially at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors and perform various checks such as the instrument calibration, spike, calibration mixes, and instrument sensitivity. The analyst will immediately notify his/her supervisor of the identified problem and the investigation that is being conducted. If the problem persists or the cause cannot be identified, the matter will be referred to the Laboratory Supervisor and Laboratory QA Manager for further investigation. When the problem has been resolved, the Laboratory QA Manager will file full documentation of the corrective action procedure, and if data are affected, the Project Chemist will be provided a corrective action memo for inclusion in the project file.

Corrective action may include, but will not be limited to, the following:

- Recalibrating analytical instruments;
- Reanalyzing suspect samples if holding time criteria permit. The need for reanalysis is dependent on the number of analytes that are out of compliance, the importance of the outlier to the decision-making process, and the magnitude of the outlying data. For example, an LCS sample with one analyte recovery at 125 percent, representing a sample batch where the average sample concentration was 10 parts per million (ppm), would not necessarily require reanalysis of the LCS or the entire sample batch;
- Re-sampling and analyzing newly collected samples;
- Evaluating and amending sampling and/or analytical procedures (with USACE concurrence);
- Accepting data with an acknowledged level of uncertainty (with USACE concurrence); and
- Evaluating and attempting to identify limitations of the data.

Following the implementation of the required corrective action measures, data still deemed unacceptable will not be accepted by the Project Manager and follow-up corrective actions will be explored.

### **9.3 CORRECTIVE ACTIONS FOLLOWING DATA REVIEW**

The Project Chemist will review the field and laboratory data generated for this project to ensure that all project QA objectives are met. If any nonconformances in the data have resulted from the field procedures, sample collection procedures, field documentation procedures, or laboratory analytical and documentation procedures, the impact of those nonconformances on the overall project QA objectives will be assessed. Appropriate actions, including re-sampling and reanalysis, may be recommended to the Cherokee Project Manager so that the project objectives can be accomplished.

## 10.0 LABORATORY DATA REDUCTION, DELIVERABLES, VALIDATION, AND REPORTING

This section describes the processes of data generation, reduction, reporting, review, and validation. First, the laboratory will generate and reduce the raw data and prepare data reports. Then, the Laboratory QA Manager will review and finalize the data report. When Farallon receives the completed data report, the Project Chemist will review one hundred percent of the data. Based on the results of the reviews and validations, additional validation may be undertaken. Farallon will prepare a final QC summary report. Data quality review responsibilities are summarized in Table 10-1.

**Table 10-1**  
**Data Quality Review Responsibilities**

Task	Project Laboratory	Cherokee/Farallon
Laboratory data quality review and data reduction	X	
Independent data review/validation		X
Quality control summary report		X

### 10.1 LABORATORY DATA REDUCTION, REVIEW, AND DELIVERABLES

Data generated by the analytical laboratory will undergo generation, reduction, and verification procedures described in the laboratory's QA plan and SOPs.

#### 10.1.1 Data Reduction Procedures

The laboratory will perform in-house analytical data reduction under the direction of the Laboratory QA Manager. Laboratory data reduction procedures will be those specified in EPA-approved methods and those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for compliance with QC criteria established in this QAPP. The analyst will also review the raw data for overall reasonableness and for transcription or calculation errors.
- After the data have been entered into the laboratory information management system (LIMS), a computerized report will be generated and sent to the laboratory supervisor or senior chemist.
- The laboratory supervisor will decide whether any sample reanalysis is required. The laboratory Project Manager will contact the Project Chemist to discuss noncompliant data sets upon discovering that any analysis fails to meet the

required data quality criteria. If corrective actions have been taken and data still do not meet project QA requirements, the USACE Technical Leader will be notified.

- Upon acceptance of the preliminary reports by the Laboratory QA Manager, final reports will be generated. Final data reports will be available within approximately 30 calendar days of sample submittal.

The Laboratory Analyst will assign QC qualifiers, as described and defined in the Laboratory QA Plans, if any of the following occurs:

- The concentration of the chemical is below required reporting limit or above calibration limit.
- The concentration of the chemical is below required reporting limit but above the MDL.
- The chemical is also found in the laboratory blank.
- Spiking analyte recoveries (bias) are outside project-specified control limits (inorganic analyses only).
- Laboratory duplicate precision is outside project-specified control limits (inorganic analyses only).
- **Spiking analyte recoveries and lab duplicate precision are out of controls for organic analyses.**

Other sample-specific qualifiers will be added, as necessary, to describe QC conditions.

The laboratory will maintain detailed procedures for laboratory record keeping supporting the validity of all analytical work. Each data report package submitted will contain the laboratory's written certification that the requested analytical method was run and that all QA/QC checks were performed. The laboratory program administrators will provide copies of applicable independent third party external audits, which will become part of the central project files.

#### **10.1.2 Data Review Procedures**

The laboratory analysts have the initial responsibility for verifying the correctness and completeness of the data, based on an established set of guidelines and on the Project QC Criteria. The analysts will ensure that the following QC elements have been satisfactorily completed:

- Documentation of sampling receipt and handling is complete.
- Sample preparation information is correct and complete.
- Analysis information is correct and complete.

- Raw data, including manual integrations, have been correctly interpreted.
- Appropriate preparation and analysis procedures have been followed.
- Site-specific special sample preparation and analytical requirements have been met.
- Analytical results are correctly calculated and complete.
- QC sample results are within project QC limits.
- Laboratory blanks are within project QC limits.
- Documentation is complete. All anomalies in the preparation and analysis have been documented; holding times are documented; and all data (including data generated before and after corrective actions or cleanup are conducted) are included in the laboratory data report.

The Laboratory Supervisor or QA Manager will provide an independent peer review of the analytical data package to ensure that the following QC elements are acceptable:

- Appropriate laboratory SOPs have been referenced.
- Calibration data are scientifically sound and appropriate to the method.
- QC sample data are within project-specific limits.
- Qualitative and quantitative results are correct.
- Raw data, including manual interpretations, have been correctly interpreted.
- Documentation is complete and correct.

#### **10.1.3 Data Deliverables**

To ensure that project chemical data are sufficient to meet both qualitative and quantitative objectives, laboratory data deliverables that will permit a data quality assessment consistent with the requirements of this QAPP are required.

The laboratory will prepare and retain full analytical and associated QC documentation. The laboratory will report the data as analytical batches of 30 samples or fewer, along with associated QC reporting data. The analytical results will be submitted in both hard copy and electronic formats (see Appendix E of the FMP QAPP) for review by Cherokee and Farallon. Data packages will be unbound and paginated.

Information provided will be sufficient to review the data with respect to:

- Holding times and conditions;
- Calibrations and instrument tunes;

- Detection/Quantitation limits;
- Spike and surrogate recoveries;
- Duplicate analyses (laboratory duplicates and MS/MSDs);
- Laboratory control samples;
- Blank contamination;
- Precision and accuracy;
- Representativeness;
- Comparability; and
- Completeness.

The analytical data will be provided in a complete CLP-type deliverable data format including the following hard copy information for each analytical data package:

- Cover sheet listing the samples included in the report;
- Narrative comments describing problems encountered in analysis; identification of any analyses not meeting quality control criteria, including holding times; and cautions regarding nonquantitative use or unusability due to out-of-control-limit QC results;
- Chain-of-custody forms and cooler receipt forms;
- Tabulated results of inorganic and organic compounds identified and quantified, with analyte-specific MRL as presented in Appendix A of the FMP QAPP. All analytes will be reported for each sample as a detected concentration or as not detected above the specific limits of quantitation, which must be stated. The laboratory will also report MDLs, dilution factors, date of extraction, extraction batch number, cleanup procedures used, date of analysis, surrogate percent recoveries, batch run logs, and analytical batch number for each sample, with corresponding sample results;
- Analytical results for QC sample spikes, laboratory duplicates, initial and continuing calibration, verifications of standards and laboratory blanks, standard procedural blanks, LCSs, laboratory reference materials, ICP interference check samples, and detection limit check samples;
- Documentation of rationale for the use of method of standard addition if required;
- Documentation of any cleanup procedures used;

- Raw data system printouts (or legible photocopies) identifying date of reported analysis, analyst, parameters analyzed, calibration curves, calibration verifications, second column confirmations, method blanks, any reported sample dilutions, cleanup logs, laboratory duplicates, spikes, control samples, sample spiking levels, preparation/extraction logs, run logs, and chromatograms;
- Chromatograms labeled with analyte peaks, internal standards, and surrogate standards where applicable; and
- Mass calibration and mass spectral tuning data for GC and GC/MS analyses.

Data reduction and QC review steps will be documented, signed, and dated by an authorized representative.

## **10.2 INDEPENDENT DATA REVIEW**

One hundred percent of all laboratory data will receive an independent summary level validation.

Independent data review involves three steps:

- Assessment of the reliability of data based on quality control sample results;
- Verification that requirements contained in the project planning documents have been met; and
- Assessment of the data usability.

The data quality review will include evaluation of laboratory summary forms for precision, accuracy, representativeness, comparability, completeness, and a summary of qualified data, but will not include review of raw data or re-calculation of reported results. The review report provides a list of all samples being reviewed, a narrative summarizing each review topic (e.g., calibration or hold times), qualified results, worksheets, and any data re-submitted by the laboratory at the request of the reviewer.

The data validation process for this project will follow the procedures in EPA Functional Guidelines (USEPA 1994, 1999, and 2001) modified for the methods used and project-specific criteria. The review will include verification of the following:

- Compliance with the QAPP;
- Proper sample preservation and handling procedures;
- Holding times;
- Initial and continuing calibrations;
- MDL and MRL;

- QC results (for example, surrogate, MS/MSD and LCS recoveries; MS/MSD, field duplicate and laboratory duplicate RPDs; serial dilutions);
- Laboratory blank and trip blank analyses;
- Data completeness and format; and
- Data qualifiers assigned by the laboratory.

Qualifiers will be added to data during review as necessary. Qualifiers applied to the data as a result of the independent review will be limited to:

- U The analyte was analyzed for, but was not detected above the sample-specific reporting limit.
- J The analyte was positively identified; the associated numerical value is an estimate of the concentration of the analyte in the sample.
- UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation.
- R The analyte's results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Results of the QA review will be included in a data quality review report that will provide a basis for meaningful interpretation of the data quality, and will evaluate the need for corrective actions and/or comprehensive data validation. This report will be used to generate the quality control summary report.

### **10.3 QUALITY CONTROL SUMMARY REPORT**

After the field work and the final analytical data have been completed and reviewed, a final QC summary report will be prepared by Farallon. The report will summarize QA and audit information, including the results of the data review; evaluate field QC sample data, such as field duplicates and trip blanks; indicate any corrective actions taken; and describe overall compliance with the SAP and the project DQOs. The report will also list the number of field QC samples collected and the number of laboratory QC analyses conducted. When control limits are exceeded, the result will be listed along with the applicable control limit.

Proposed topics to be included in the Quality Control Summary Report are:

- Project scope;

- Project description;
- Sampling procedures;
- Quality control activities;
- Analytical procedures;
- Chemical data quality assessment (field duplicate results, detected analyte table, total results table(s), and rejected or qualified results table); and
- Conclusions and recommendations.

The QC summary report will be included in the central project file and incorporated as part of the Site Closure Report, will provide a basis for meaningful interpretation of the data quality, and will evaluate the need for further corrective actions.

## 11.0 REFERENCES

- URS Corporation (URS). 2002. *Draft Site Investigation Report, Former North Pacific Division Laboratory, Troutdale, Oregon*. Prepared for U.S. Army Corps of Engineers, Seattle District, Seattle, Washington, by URS Corporation, Seattle, Washington. April.
- \_\_\_\_\_. 2001. *Final Management Plan, Site Investigation, Former North Pacific Division Laboratory, Troutdale, Oregon*. Prepared for the U.S. Army Corps of Engineers, Portland District, Seattle, Washington. August.
- U.S. Army Corps of Engineers (USACE). 2001. *Engineering Manual 200-1-3, Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans. Appendix I, Shell for Analytical Chemistry Requirements*. February 12.
- U.S. Environmental Protection Agency (USEPA). 2001. *USEPA Contract Laboratory Program National Functional Guidelines for Low-Concentrations Organic Data Review*. EPA-540-R-00-006. June.
- \_\_\_\_\_. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA-540/R-99/008. October.
- \_\_\_\_\_. 1998. *Test Methods for Evaluation of Solid Waste, Vol. II: Field Manual Physical/Chemical Methods (SW-846)*. 3<sup>rd</sup> ed. And Revised Update IIIA. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. April.
- \_\_\_\_\_. 1994. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA-540/R-94/013. February.
- Washington State Department of Ecology. 1997. *Analytical Methods for Petroleum Hydrocarbons*. Publication No. ECY 97-602. June.

**ATTACHMENT A**  
**LABORATORY REPORTING LIMITS AND CLEANUP LEVELS**

### Laboratory Reporting Limits and Cleanup Levels

Chemicals of Concern <sup>a</sup>	Lab Soil PQLs <sup>b</sup> (µg/Kg)	2000 EPA Region 9 Soil PRGs <sup>c</sup> (mg/kg)	2002 EPA Region 9 Soil PRGs <sup>d</sup> (mg/kg)
VOLATILE ORGANIC COMPOUNDS			
Dichlorodifluoromethane	1.0/200	310 nc	310 nc
Chloromethane	1.0/200	2.7 ca	2.6 ca
Vinyl chloride	1.0/200	0.83 ca	0.75 ca
Bromomethane	5.0/400	13 nc	13 nc
Chloroethane	1.0/200	6.5 ca	6.5 ca
Trichlorofluoromethane	1.0/200	2,000 sat	2,000 sat
1,1-Dichloroethene	1.0/200	0.12 ca	0.12 ca
1,1,2-Trichloro-1,2,2-trifluoroethane	1.0/200	5,600 sat	—
Acetone	10/4,000	6,200 nc	6,000 nc
Carbon disulfide	1.0/200	720 sat	720 sat
Methyl acetate	20/10,000	96,000 nc	92,000 nc
Methylene chloride	1.0/200	21 ca	21 ca
trans-1,2-Dichloroethene	1.0/200	210 nc	—
Methyl tert butyl ether (MTBE)	1.0/200	37 ca	160 ca
1,1-Dichloroethane	1.0/200	2,100 nc	1,700 nc
cis-1,2-Dichloroethene	1.0/200	150 nc	—
2-Butanone (MEK)	10/10,000	NE	—
Chloroform	1.0/200	0.52 ca	12 ca/nc
1,1,1-Trichloroethane	1.0/200	1,400 ca	1,200 ca
Cyclohexane	1.0/200	140 sat	140 sat
Carbon tetrachloride	1.0/200	0.53 ca	0.55 ca
Benzene	1.0/200	1.5 ca	1.3 ca
1,2-Dichloroethane (Ethylene dichloride)	1.0/200	0.76 ca	0.6 ca
Trichloroethene	1.0/200	6.1 ca	6.1 ca
Methylcyclohexane	1.0/200	8,800 nc	8,700 nc
1,2-Dichloropropane	1.0/200	0.77 ca	0.74 ca
Bromodichloromethane	1.0/200	2.4 ca	1.8 ca
1,3-Dichloropropene (DCP), total	1.0/200	—	1.8 ca
cis-1,3-Dichloropropene (see 1,3-DCP, total)	1.0/200	NE	-
4-Methyl-2-pentanone (Methyl isobutyl ketone)	5.0/1,000	NE	2,800 nc
Toluene	1.0/200	520 sat	—
trans-1,3-Dichloropropene (see 1,3-DCP, total)	1.0/200	NE	—

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1,1,2-Trichloroethane	1.0/200	1.9 ca	1.6 ca
Tetrachloroethene	1.0/200	19 ca	—
2-Hexanone	5.0/2,000	NE	—
Dibromochloromethane	1.0/200	2.7 ca	2.6 ca
1,2-Dibromoethane (Ethylene dibromide [EDB])	1.0/200	0.048 ca	0.028 ca
Chlorobenzene	1.0/200	540 nc	530 nc
Ethylbenzene	1.0/200	230 sat	
Xylenes (total)	3.0/400	210 sat	420 sat
Styrene	1.0/200	1,700 sat	1,700 sat
Bromoform	1.0/200	310 ca	220 ca
Isopropylbenzene (cumene)	1.0/200	NE	—
1,1,2,2-Tetrachloroethane	1.0/200	0.9 ca	0.93 ca
1,3-Dichlorobenzene	1.0/200	52 nc	63 nc
1,4-Dichlorobenzene	1.0/200	8.1 ca	7.9 ca
1,2-Dichlorobenzene	1.0/200	370 sat	—
1,2-Dibromo-3-chloropropane	2.0/200	4.0 ca	2 ca
1,2,4-Trichlorobenzene	1.0/200	3,000 sat	3,000 sat
Total trihalomethanes	1.6/200	—	—
SEMIVOLATILE ORGANIC COMPOUNDS			
Benzaldehyde	100	88,000 nc	62,000 nc
Phenol			
	50	100,000 max	100,000 max
bis(2-Chloroethyl) ether	50	0.62 ca	0.55ca
2-Chlorophenol	50	240 nc	240 nc
2-Methylphenol	50	44,000 nc	31,000 nc
2,2'-Oxybis(1-chloropropane)=[bis (2-chloroisopropyl) ether]	50	—	—
Acetophenone	100	1.6 nc	—
4-Methylphenol	50	—	3,100 nc
n-Nitroso-di-n-propylamine	50	.35 ca	.25 ca
Hexachloroethane	40	180 ca	120 ca
Nitrobenzene	50	110 nc	100 nc
Isophorone	50	2,600 ca	1,800 ca
2-Nitrophenol	50	NE	—

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2,4-Dimethylphenol	50	18,000 nc	12,000 nc
bis(2-Chloroethoxy)methane	50	NE	—
2,4-Dichlorophenol	50	2,600 nc	1,800 nc
Naphthalene	10	190 nc	—
4-Chloroaniline	50	3,500 nc	2,500 nc
Hexachlorobutadiene	50	32 ca	22 ca
Caprolactam	100	100,000 max	100,000 max
4-Chloro-3-methylphenol	50	NE	—
2-Methylnaphthalene	10	NE	—
Hexachlorocyclopentadiene	50	5,900 nc	3,700 nc
2,4,6-Trichlorophenol	50	220 ca	62 nc
2,4,5-Trichlorophenol	50	88,000 nc	62,000 nc
1,1'-Biphenyl	50	—	350 sat
2-Chloronaphthalene	10	27,000 nc	23,000 nc
2-Nitroaniline	50	50 nc	18 nc
Dimethylphthalate	50	100,000 max	100,000 max
2,6-Dinitrotoluene	50	880 nc	620 nc
Acenaphthylene	10	NE	—
3-Nitroaniline	50	NE	—
Acenaphthene	10	38,000 nc	29,000 nc
2,4-Dinitrophenol	50	1,800 nc	1,200 nc
4-Nitrophenol	50	7,000 nc	—
Dibenzofuran	50	5,100 nc	3,100 nc
2,4-Dinitrotoluene	50	1,800 nc	1,200 nc
Fluorene	10	33,000 nc	26,000 nc
Diethylphthalate	50	100,000 max	100,000 max
4-Chlorophenyl-phenyl-ether	50	NE	—
4-Nitroaniline	50	NE	—
4,6-Dinitro-2-methylphenol	50	NE	—
n-Nitrosodiphenylamine	50	500 ca	350 ca
4-Bromophenyl-phenyl ether	50	NE	—
Hexachlorobenzene	50	1.5 ca	1.1 ca
Atrazine	50	11 ca	7.8 ca
Pentachlorophenol	50	11 ca	9 ca
Phenanthrene	10	NE	—

### Laboratory Reporting Limits and Cleanup Levels

Chemicals of Concern <sup>a</sup>	Lab Soil PQLs <sup>b</sup> (µg/Kg)	2000 EPA Region 9 Soil PRGs <sup>c</sup> (mg/kg)	2002 EPA Region 9 Soil PRGs <sup>d</sup> (mg/kg)
Anthracene	10	100,000 max	100,000 max
Carbazole	50	—	86 ca
Di-n-butylphthalate	50	88,000 nc	—
Fluoranthene	10	30,000 nc	22,000 nc
Pyrene	10	54,000 nc	29,000 nc
Butylbenzylphthalate	50	100,000 max	100,000 max
3,3'-Dichlorobenzidine	50	5.5 ca	3.8 ca
Benzo(a)anthracene	10	2.9 ca	2.1 ca
Chrysene	10	290 ca	210 ca
bis-(2-Ethylhexyl) phthalate	50	180 ca	120 ca
Di-n-octylphthalate	50	10,000 sat	25,000 nc
Benzo(b)fluoranthene	10	2.9 ca	2.1 ca
Benzo(k)fluoranthene	10	29 ca	21 ca
Benzo(a)pyrene	10	0.29 ca	0.21 ca
Indeno(1,2,3-c,d)pyrene	10	2.9 ca	2.1 ca
Dibenzo(a,h)anthracene	10	0.29 ca	—
Benzo(g,h,i)perylene	10	NE	—
PESTICIDES AND PCBs			
Aldrin	1	0.15 ca	0.1 ca
α-BHC	1	0.59 ca	—
β-BHC	1	2.1 ca	—
γ-BHC (Lindane)	1	2.9 ca	—
δ-BHC	1	—	—
Chlordane, technical	10	11 ca	6.5 ca
α-Chlordane	1	—	—
γ-Chlordane	1	—	—
4,4'-DDD	2	17 ca	10 ca
4,4'-DDE	2	12 ca	7 ca
4,4'-DDT	2	12 ca	7 ca
Dieldrin	2	0.15 ca	0.11 ca
Endosulfan	2	53,000 nc	3,700 nc
Endosulfan I	1	(see Endosulfan)	—
Endosulfan II	2	(see Endosulfan)	—
Endosulfan sulfate	2	—	—
Endrin	2	260 nc	180 nc

### Laboratory Reporting Limits and Cleanup Levels

Chemicals of Concern <sup>a</sup>	Lab Soil PQLs <sup>b</sup> (µg/Kg)	2000 EPA Region 9 Soil PRGs <sup>c</sup> (mg/kg)	2002 EPA Region 9 Soil PRGs <sup>d</sup> (mg/kg)
Endrin aldehyde	2	—	—
Endrin ketone	2	—	—
Heptachlor	1	0.55 ca	0.38 ca
Heptachlor epoxide	1	0.27 ca	1.9 ca
Methoxychlor	10	4,400 nc	3,100 nc
Toxaphene	100	2.2 ca	1.6 ca
Aroclor® 1016	10	29 ca	21 ca
Aroclor® 1221	20	1.0 ca	0.74 ca
Aroclor® 1232	10	1.0 ca	0.74 ca
Aroclor® 1242	10	1.0 ca	0.74 ca
Aroclor® 1248	10	1.0 ca	0.74 ca
Aroclor® 1254	10	1.0 ca	0.74 ca
Aroclor® 1260	10	1.0 ca	0.74 ca
METALS			
Aluminum	40	100,000 max	100,000 max
Antimony	100	820 nc	410 nc
Arsenic (soil by 6020)	1	2.7 ca	1.6 ca
Barium	1	100,000 max	67,000 max
Beryllium	0.4	2,200 ca	1,900 ca
Cadmium (soil by 6020)	0.5	810 nc	450 nc
Calcium	200	—	—
Chromium, total	2	450 ca	450 ca
Cobalt	2	100,000 max	1,900max
Copper	4	76,000 nc	41,000 nc
Iron	20	100,000 max	100,000 max
Lead (soil by 6020)	0.5	750 nc	750 nc
Magnesium	200	—	—
Manganese	3	32,000 nc	19,000 nc
Mercury	0.1	610 nc	310 nc
Nickel	8	41,000 nc	20,000 nc
Potassium	400	—	—
Selenium	80	10,000 nc	5,100 nc
Silver (soil by 6020)	0.5	10,000 nc	5,100 nc
Sodium	100	—	—
Strontium	10	100,000 max	100,000 max

### Laboratory Reporting Limits and Cleanup Levels

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Thallium	100	130 nc	67 nc
Uranium (soil by 6020)	0.1	410 nc	200 nc
Vanadium	10	14,000 nc	7,200 nc
Zinc	4	100,000 max	100,000 nc
Cyanide	0.2	35 nc	35 nc
TPH-Diesel	25	—	—

**NOTES:**

<sup>a</sup> Compounds listed for VOCs, SVOCs, pesticides and PCBs, and analytes listed for metals and cyanide are based on the EPA Contract Laboratory Program Target Compound Lists and CLP Target Analyte Lists.

<sup>b</sup> 1.0/200 indicates the PQL for the SW846 method 5035 applicable to samples anticipated to contain concentrations less than 200

<sup>c</sup> 2000 EPA Region 9 PRGs for industrial soils.

<sup>d</sup> 2002 EPA Region 9 PRGs for industrial soils.

µg/kg and for the method applicable to samples anticipated to contain concentration greater than 200 ug/kg.

— denotes criteria not established

ca = cancer

max = maximum soil contamination level

NA = not applicable

nc = noncancer

PQL = practical quantitation limit equivalent to the method reporting limit (MRL)

PRG = preliminary remedial goal

sat = saturated soil